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# Additions to the rust fungi of Fairy Meadows, the Northern Areas of Pakistan

S. H. Iqbal, N. S. Afshan *, A. N. Khalid, A. R. Niazi & A. Sultan

*pakrust@gmail.com*
*Department of Botany, University of the Punjab*
*Quaid-e-Azam Campus, Lahore, 54590, Pakistan*

**Abstract** — *Puccinia silenigena* on *Silene* sp. is described as a new rust fungus from Fairy Meadows in the Pakistan Northern areas while *Leucotelium pruni-persicae* is a new record for Pakistan.

**Key words** — *Aquilegia pubiflora, Crossopsora,* Hunza, *Puccinia silenicola*

## Introduction

The Northern Areas of Pakistan are very rich floristically. About 3000 species of plants exist in these areas, out of which approximately 124 species have medicinal properties (Sultan et al. 2006).

Until 2005, only 63 species of rust fungi had been described or reported from this 72,971 km$^2$ area (Ahmad 1956a,b; Gjaerum & Iqbal 1969; Kaneko 1993; Kakishima et al. 1993a,b; Khalid et al. 1995; Khalid & Iqbal 1996a,b, 1997; Ahmad et al. 1997; Sultan 2005; Sultan et al. 2008). This paper is a continuation of the enumeration of rust fungi of this area.

In this present work, *Puccinia silenigena* is described as a new rust fungus on *Silene* sp. from Fairy Meadows in the Northern Areas of Pakistan. *Leucotelium pruni-persicae* is a new record for Pakistan. *Puccinia brachypodii* var. *poae-nemoralis* is an addition to the rust flora of Northern Areas of Pakistan with *Anthoxanthum odoratum* as a new host for rust fungi of Pakistan.

## Materials and methods

Specimens were collected from the Northern Areas of Pakistan. Freehand sections of infected tissues and spores were mounted in lactophenol and gently heated to boiling. The preparations were observed under a NIKON YS 100 microscope and photographed with a digipro-Labomed and Scanning Electron Microscope. Drawings of spores and paraphyses were made using a Camera

* Corresponding author

Lucida (Ernst Leitz Wetzlar, Germany). Spore dimensions were taken with an ocular micrometer. At least 25 spores were measured for each spore state. The rusted specimens have been deposited in the Herbarium of Botany department, University of the Punjab, Lahore (LAH).

## Enumeration of taxa

***Puccinia silenigena*** S.H. Iqbal, Afshan & Khalid, sp. nov. FIGS. A–C
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*Spermogonia et aecia ignota.* Uredinia amphigena, *brunnea. Urediniosporae ovoideae vel ellipsoideae, 19–26 × 23–32 µm (mean 22.64 × 27.29 µm); membrana 1.5–2 µm crassa, pallidae-brunneae, echinulatae; poris germinationis 3–4, obscures. Telia amphigena, atra. Teliosporae ellipsoideae vel obovoideae, medio leviter constrictae, raro diorchidioideae, (16–)19–24 × (29–)31–42(–46) µm (mean 21.42 × 36.67 µm); membrana 1.5–2 µm crassa, castaneo-brunneae; apice 2–5 µm crassa; poro germinationis 1 per cellulam, subapicaliter vel aequatorialis; pedicello hyalinae, oblique.*

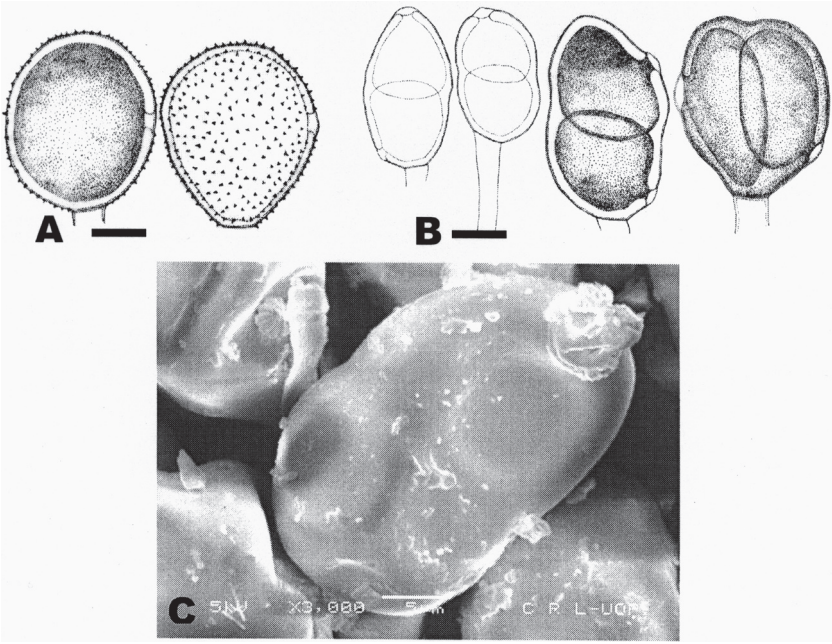
**HOLOTYPE:** On *Silene* sp., with II & III stages, Pakistan, Northern Areas, Fairy Meadows, at 3,036 m a. s. l., 12th August, 2007. NSA # G 11. (LAH Herbarium No. NSA 1088).

ETYMOLOGY: Named after the host plant, *Silene* sp.

SPERMOGONIA and AECIA unknown. UREDINIA amphigenous, brown, 0.1–0.2 × 0.2–0.4 mm. UREDINIOSPORES ovoid to ellipsoid, 19–26 × 23–32 µm (mean 22.64 × 27.29 µm); wall 1.5–2 µm thick, pale brown, echinulate; germ pores 3–4, obscure; pedicel hyaline, short, 6–8 × 15–20 µm. TELIA mostly amphigenous, 0.2–0.4 × 0.2–0.6 mm, black. TELIOSPORES ellipsoid to obovoid, rounded at both ends, sometimes diorchidioid, not or slightly constricted at the septum, (16–)19–24 × (29–)31–42(–46) µm (mean 21.42 × 36.67 µm); wall 1.5–2 µm thick, smooth, chestnut brown; apex 2–5 µm thick; germ pore 1 per cell, upper sub-apical, lower at the equator or near the septum; pedicel short, hyaline, obliquely attached, 5–6 × 24–30 µm.

COMMENTS: Previous reports from Pakistan of rust fungi on *Silene* spp. are *Uromyces behenis* (DC.) Unger on *Silene vulgaris* (Moench) Garcke from Swat (Ono & Kakishima 1992) and *S. aucheriana* Boiss. from Quetta (Khalid et al. 1995); and *Puccinia behenis* G.H. Otth on *S. aucheriana* from Naltar valley, Gilgit (Ahmad 1969: 110). Other rust fungi reported elsewhere on *Silene* spp. include *P. arenariae* (Schumach.) J. Schröt., *P. silenicola* Sousa da Câmara et al., and *U. inaequialtus* Lasch (Wilson & Henderson 1966: 62–64).

*P. silenigena* resembles *P. behenis* in uredinio–teliospore size and wall ornamentation. The major difference between the two *Puccinia* species is that *P. silenigena* has ellipsoid to diorchidioid teliospores with an obliquely attached pedicel while *P. behenis* has oblong to ellipsoid teliospores. In *P. silenigena,* the germ pore of upper cell is apical or sub-apical while *P. behenis* has an apical germ pore in the upper cell.

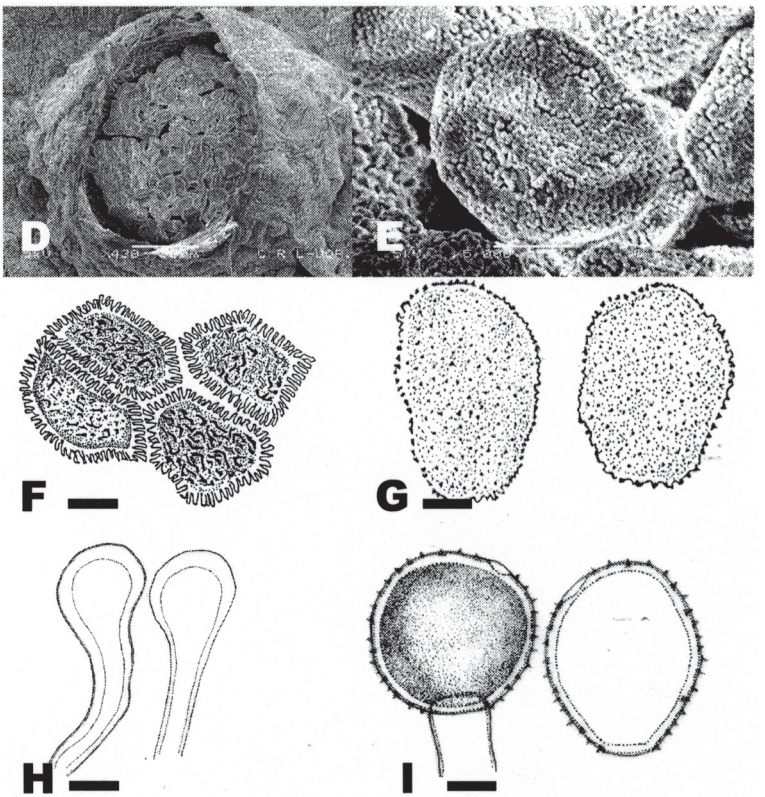



Figs. A–C: *Puccinia silenigena* (type)
(A). Lucida drawings of urediniospores and (B). Teliospores
(C). SEM photograph of a smooth walled teliospore.
Scale bar for A = 9 μm, B = 8 μm, C = 5 μm.

*P. silenigena* somewhat resembles *P. silenicola* in spore shape and wall ornamentation. However, *P. silenigena* differs in spore size with larger (19–26 × 23–32 μm vs. 18–22 × 17–26.5 μm) urediniospores and wider ((16–)19–24 μm vs. 15–19 μm) teliospores compared to *P. silenicola.* Another characteristic difference is the presence of thinner (2–5 μm vs. 6–8.5 μm) teliospore apices with shorter (24–30 μm vs. 120 μm) pedicels in *P. silenigena.*

***Leucotelium pruni-persicae*** (Hori) Tranzschel, Sovetska Bot. 4: 83 (1935) Figs. D–I
- ≡ *Puccinia pruni-persicae* Hori, Phytopathology 2: 144 (1912)
- ≡ *Sorataea pruni-persicae* (Hori) Cummins & Y. Hirats., Illustr. Gen. Rust Fungi, rev. edit. (St. Paul): 147 (1983).

Telia not found. Spermogonia hypophyllous, inconspicuous, 0.1–0.25 mm wide and 0.2–0.3 mm high, honey colored to reddish brown, surrounded by aecia. Aecia hypophyllous, scattered, on leaves, petioles and branches, yellow to yellowish orange, 0.2–0.3 × 0.3–0.4 mm, cup shaped, clustered together in the form of a circle. Aeciospores subglobose or ovoid–obovoid, hyaline to light




Figs. D–I: *Leucotelium pruni-persicae* (D). SEM photograph of an aecium (E). SEM photograph of aeciospores showing verrucose wall ornamentation (F). Lucida drawing of peridial cells (G). Aeciospores (H). Capitate paraphyses (I). Urediniospores. Scale Bar for F = 9 µm, G = 6 µm, H & I = 10 µm

yellow, sometimes with yellowish orange granules, verrucose, 15–20 × 19–24 µm. Peridial cells hyaline to light yellow, rhomboidal to irregular in shape, verrucose to striately verrucose, 16–24 × 23–27 µm. Uredinia hypophyllous, scattered or sometimes in groups, minute, light yellow to yellowish orange, powdery. Urediniospores globose to subglobose or obovoid to ellipsoid, 16–20 × 18–25 µm (mean 17.69 × 20.12 µm); wall 1–1.5 µm thick, hyaline to light yellow, echinulate; germ pores obscure; pedicel hyaline, fragile, 6–8 × 15–20 µm. Paraphyses clavate to capitate, hyaline to light yellow, 18–21 µm wide at apex, 8–10 µm thick at lower portion, wall of apex 2–5 µm thick, up to 71 µm long.

Material examined: On *Aquilegia pubiflora* Royle, with 0 & I stages, Pakistan, North West Frontier Province (NWFP), Ayubia National Park, at 2,135 m a. s. l., 24th May, 2006. NSA # 05. (LAH Herbarium No. NSA 1016); on *Prunus amygdalus* Batsch, with II stage, Pakistan, Northern Areas, Hunza, at 2,440 m a. s. l., 13th August, 2007, NSA # G18. (LAH Herbarium No. NSA 1017).

Comments: *Leucotelium pruni-persicae* is a new record for Pakistan. *Tranzschelia pruni-spinosae* (Pers.) Dietel and *T. pruni-spinosae* var. *discolor* (Fuckel) Dunegan (≡ *T. discolor* (Fuckel) Tranzschel & M.A. Litv.) were previously reported on *Prunus amygdalus* and *P. persica* (L.) Batsch from Tandojam and Choa Saiden Shah by Khan & Kamal (1968), Ahmad (1956a,b), Malik et al. (1968), Malik & Virk (1968), and Ahmad (1976). In China and Japan, *L. pruni-persicae* has been reported on *Aquilegia* species as the aecial hosts and *Prunus* species as the telial hosts (Farr et al. 2008).

***Puccinia brachypodii*** var. ***poae-nemoralis*** (G.H. Otth) Cummins & H.C. Greene, Mycologia 58: 705 (1966) Figs. J–K

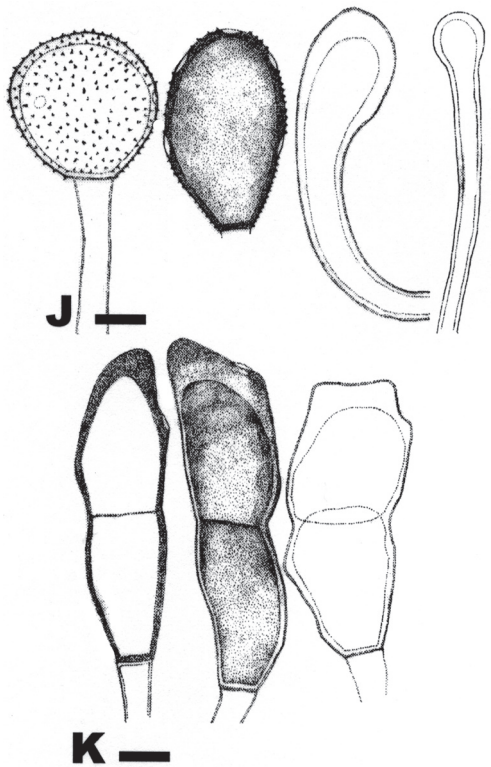
≡ *Puccinia poae-nemoralis* G.H. Otth, Mitt. naturf. Ges. Bern: 113 (1871) ["1870"]

= *Puccinia anthoxanthina* Gäum., Ber. Schweiz. bot. Ges. 55: 74 (1945)

Spermogonia and aecia not seen. Uredinia mostly on adaxial surface, yellowish or yellowish brown, 0.09–0.2 × 0.2–0.4 mm. Urediniospores obovoid or ellipsoid to broadly ellipsoid, 19–26 × 23–36 µm (23.18 × 28.63 µm); wall 2–3 µm thick, light brown to cinnamon brown, closely echinulate; germ pores 5–9, obscure; pedicel hyaline, short, 7–8 × 38–45 µm. Paraphyses cylindric to capitate, hyaline or yellowish, mostly 80–100 µm long and 14–18 µm wide, usually geniculata, wall 2–4 µm thick throughout or to 6 µm thick in the head. Telia mostly on the abaxial surface, covered by the epidermis, 0.06–0.1 × 0.1–0.2 mm, black, loculate with a few brown paraphyses surrounding the sori. Teliospores oblong to clavate, 13–24 × 40–59(–65) µm (mean 17.72 × 50.58 µm), not or slightly constricted at the septa; wall 1–1.5 µm thick, smooth, brown to chestnut brown or paler basally; apex 5–9 µm thick, truncate or conical; germ pore 1 per cell, upper sub-apical, lower at the equator or near the septum; pedicel short, light brown, not collapsing, thick walled, 5–6 × 9–15 µm. Few one-celled spores also observed.

Material examined: On *Anthoxanthum odoratum* L., with II + III stages, Pakistan, Northern Areas, Karimabad, Hunza, at 2,438 m a. s. l., 13th August, 2007. NSA # Gr 58 (G06). (LAH Herbarium No. NSA 1035).

Comments: *Puccinia brachypodii* var. *poae-nemoralis* has previously been reported on leaves of *Agrostis munroana* Aitch. & Hemsl., *Poa nemoralis* L., *P. pratensis* L., and *P. sterilis* M. Bieb. from Kaghan valley, Sharhan, Swat, and Azad Jammu & Kashmir (Ahmad et al. 1997). The aecial state is known to occur on *Berberis* species elsewhere in the western Himalayas (Joshi & Payak 1963).




Figs. J–K: Lucida drawings of *Puccinia brachypodii* var. *poae-nemoralis* (J). Urediniospores and paraphyses (K). Teliospores. Scale bar = 10 µm.

*P. brachypodii* var. *poae-nemoralis* is reported here for the first time from Hunza, Northern Areas of Pakistan, and *Anthoxanthum odoratum* is recorded for the first time as a host for rust fungi in Pakistan, although it is a host elsewhere in the world (Farr et al. 2008).

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